UM10904

SSL5257DB1351 3.3 V standby/auxiliary power supply to power a microcontroller for smart lighting interfaces

Rev. 1 — 9 September 2015 **User manual**

Document information

Info	Content
Keywords	SSL5257DB1351, SSL5257TE, Solid-State Lighting (SSL) applications, standby/auxiliary power supply, smart lighting interfaces
Abstract	This user manual describes the SSL5257DB1351 demo board of a standby/auxiliary power supply. The power supply generates a 3.3 V supply for a microcontroller used in SSL or smart lighting applications. The application features the SSL5257TE.

Revision history

Rev	Date	Description
v.1	20150909	first issue

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1. Introduction

WARNING

Lethal voltage and fire ignition hazard

The non-insulated high voltages that are present when operating this product, constitute a risk of electric shock, personal injury, death and/or ignition of fire.

This product is intended for evaluation purposes only. It shall be operated in a designated test area by personnel qualified according to local requirements and labor laws to work with non-insulated mains voltages and high-voltage circuits. This product shall never be operated unattended.

The SSL5257DB1351 is a demo board of a 3.3 V standby/auxiliary power supply which is used to power microcontrollers in smart lighting systems.

The SSL5257DB1351 demo board provides a simple and effective solution for a 3.3 V standby/auxiliary power supply. It is implemented on a small PCB with a minimum component count and features the SSL5257TE.

Target applications are smart lighting applications, downlight applications featuring Visual Light Communication (VLC), and fixture applications using microcontrollers having both analog and Pulse-Width Modulation (PWM) dimming capabilities.

The SSL5257TE is a dimmable SSL controller. It is used in this application to generate a constant voltage output.

The SSL5257DB1351 demo board provides both good line regulation and load regulation.

The single PCB dimensions are 27 mm × 20 mm with CEM-3 or FR4 material and copper thickness of 80 μm.

1.1 Features

- 3.3 V standby/auxiliary supply for primary side housekeeping
- Integrated HV MOSFET and start-up current source
- HSO8 with exposed die pad
- Good line regulation and load regulation
- Low power losses
- Low component count (15 components including the SSL5257TE)
- Single-sided PCB; dimensions: 27 mm × 20 mm

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2. Safety warning

The SSL5257DB1351 demo board input is connected to output of the filtered rectified mains. Avoid touching the board while it is connected to the mains voltage and when it is in operation. An isolated housing is obligatory when used in uncontrolled, non-laboratory environments. Galvanic isolation from the mains phase using a fixed or variable transformer is always recommended. Figure 1 shows the symbols on how to recognize these devices.

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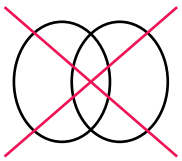
a. Isolated



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b. Not isolated

Fig 1. Isolation symbols

3. Specifications

Table 1. SSL5257DB1351 specifications

Symbol	Parameter	Value
-	IC used	SSL5257TE
V_{RECT}	rectified mains voltage	170 V (DC) or 325 V nominal
V_{out}	output voltage	3 V to 3.6 V; 3.3 V nominal
I_{out}	output current	10 mA typical; < 50 mA
$\Delta V_{out}/\Delta I_{out}$	load regulation	< −10 % for < 50 mA
-	L × W	27 mm × 20 mm
-	CEM-3; FR4	0.8 mm (Cu = 35 μm)

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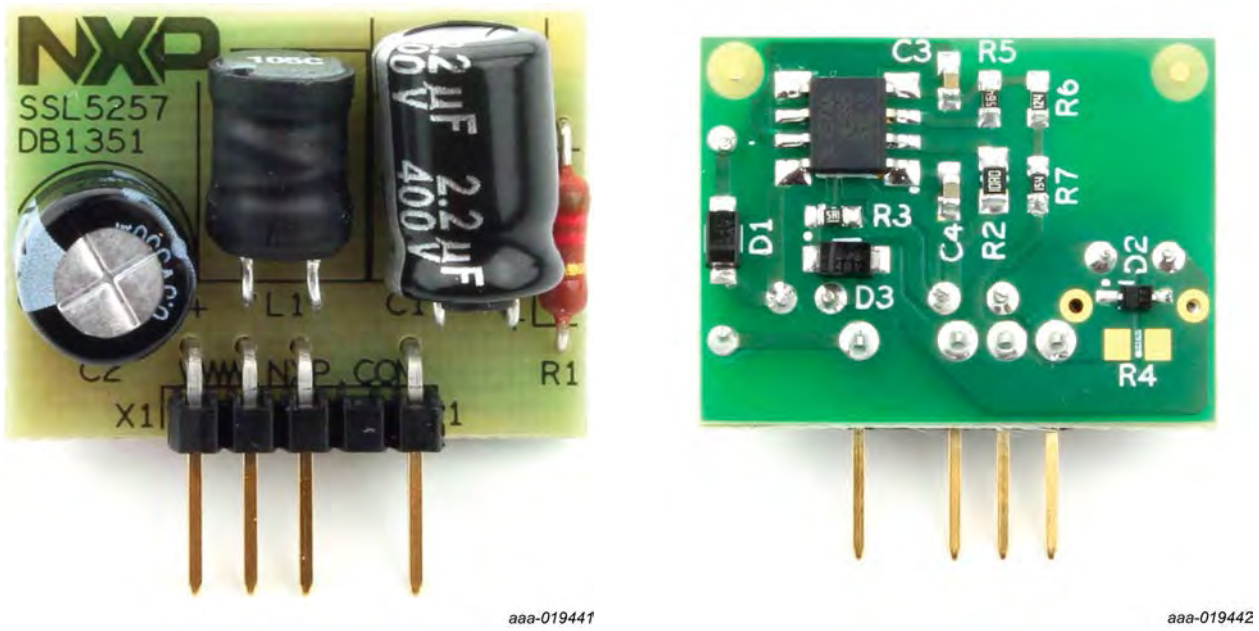
4. Board photographs



a. Top b. Bottom

Fig 2. SSL5257DB1351 photographs

5. Board connections

Fig 3. SSL5257DB1351 board connections

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6. Functional description

When the voltage on the DIM pin is connected to ground, the V/I converter connected to the DIM circuit discharges the capacitor on the COMP pin with 500 nA. The 40 µs timer is also activated. The voltage on the COMP pin, V_{COMP}, operates at the minimum of its regulation on-time (t_{on}) which is corresponding with 2 V on the COMP pin. The voltage can be calculated with Equation 1:

$$V_{out} = V_{CC} \cdot \frac{R2}{R1} - V_{COMP} \cdot \frac{R1 + R2}{R1} - 500\ nA \cdot R1 \quad (1)$$

Example:

- V_{CC} = 13.6 V
- V_{COMP} = 2 V
- R1 = 560 kΩ
- R2 = 270 kΩ

The result: V_{out} = 3.3 V

During t_{off}, the average V/I current is regulated to I_{ref}.

The secondary stroke begins once $V_{ton} > V_{COMP}$ or $V_{ISNS} > 0.9$ V (see Figure 4).

The primary stroke begins when $V_{ISNS} > 25$ mV (i.e. energize level) and demagnetization/valley is detected at the DEMOVP pin or when the 40 µs timer is completed.

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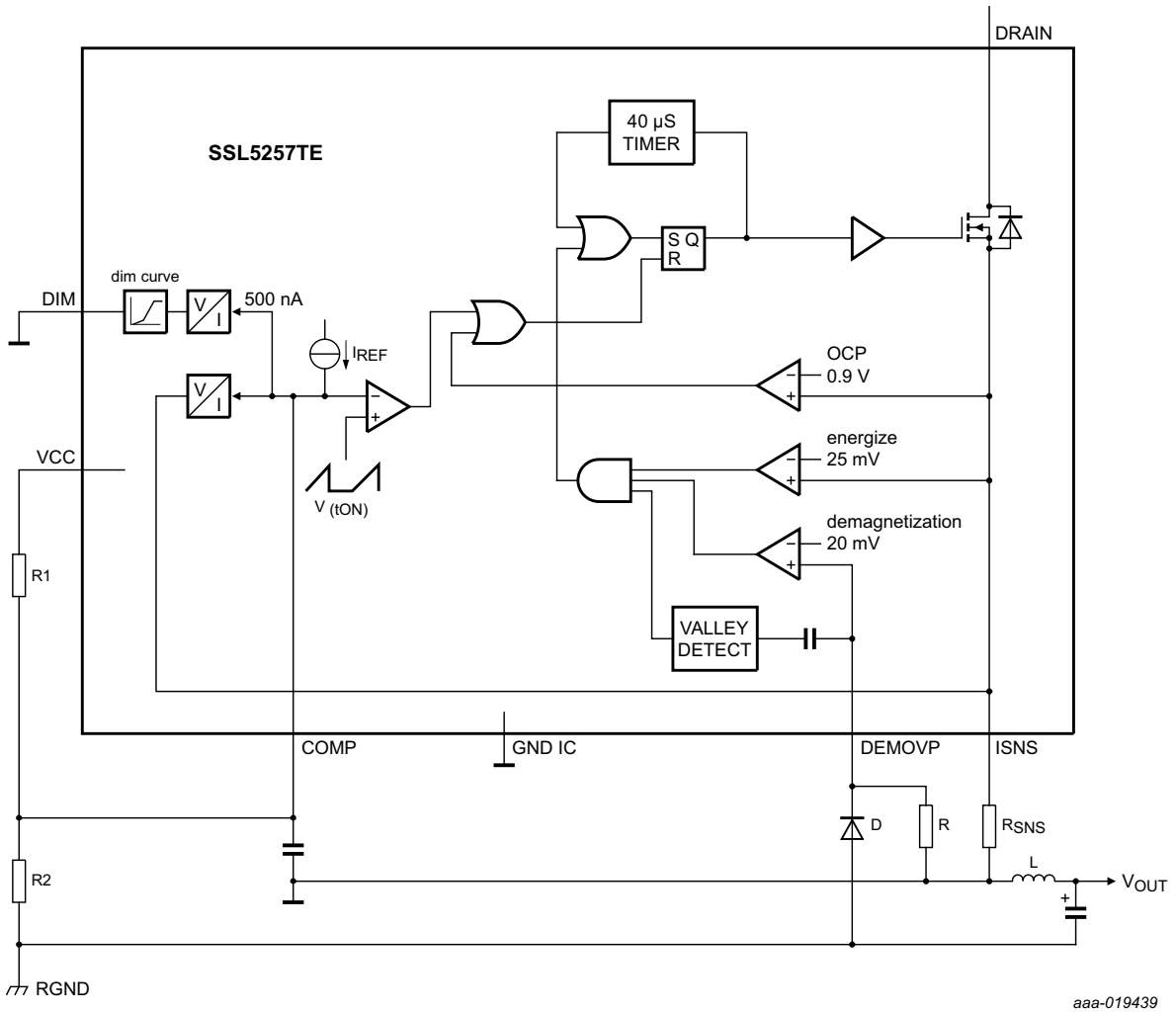

Fig 4. Internal block schematic with application components

The current through L during the secondary stroke (i.e. during the t_{off} period when the MOSFET is switched off and the freewheel diode is conducting) and resistor R determine the voltage on the DEMOVP pin.

The current through L during the primary stroke (i.e. during the t_{on} period and the MOSFET is switched on) and resistor R_{SNS} determine the voltage on the ISNS pin (V_{ISNS}).

Depending on the output current (I_{out}) drawn from the V_{out} supply, the SSL5257TE operates in burst mode, DCM mode, or BCM mode (see Figure 5).

The minimum on-time level on the COMP pin is accurate since it is derived from the band gapped V_{CC} supply and 1 % resistors R1 and R2 in the application. Output regulation is best when by the 40 µs timer determines the controller frequency in burst mode and DCM mode.

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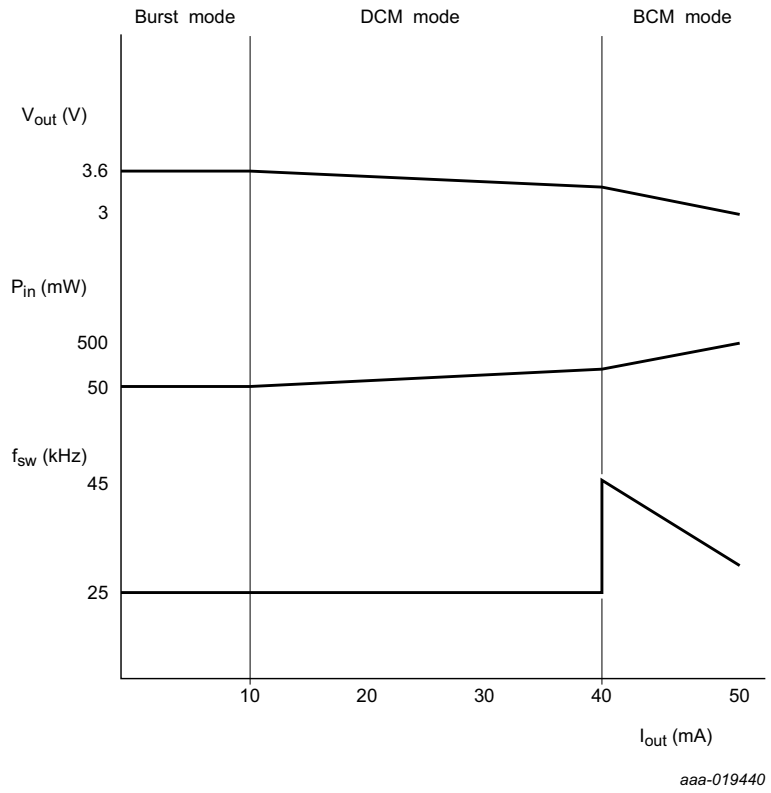

Fig 5. Output voltage, input power, and switching frequency as function of output current

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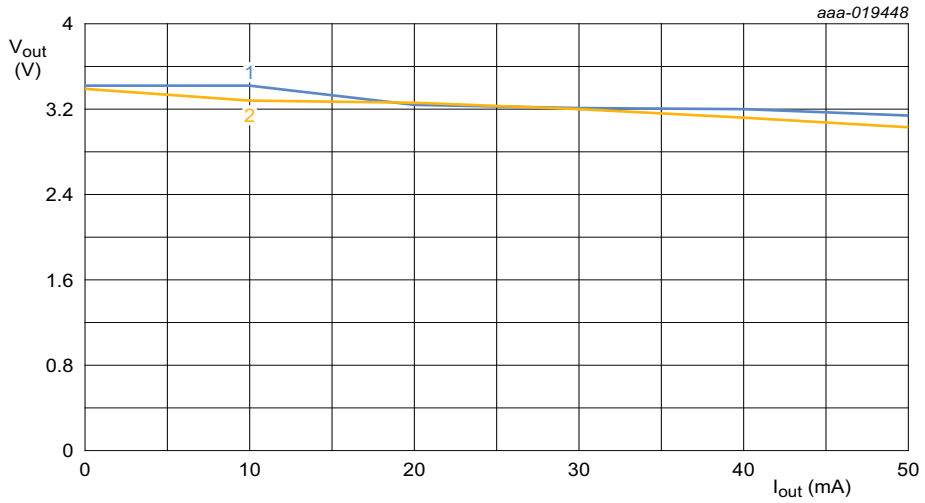
7. Performance and measurements

7.1 V_{out} versus I_{out}

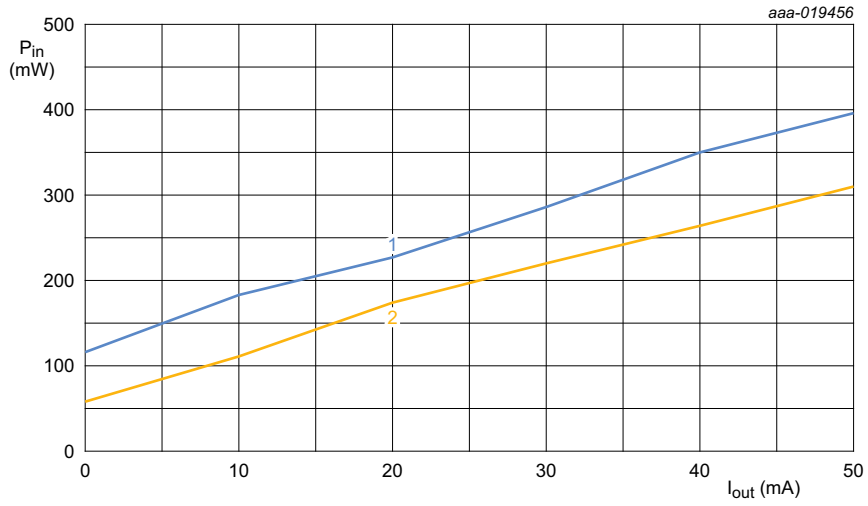


(1) 230 V

(2) 120 V

Fig 6. V_{out} as a function of I_{out}

7.2 P_{in} versus I_{out}



(1) 230 V

(2) 120 V

Fig 7. P_{in} as a function of I_{out}

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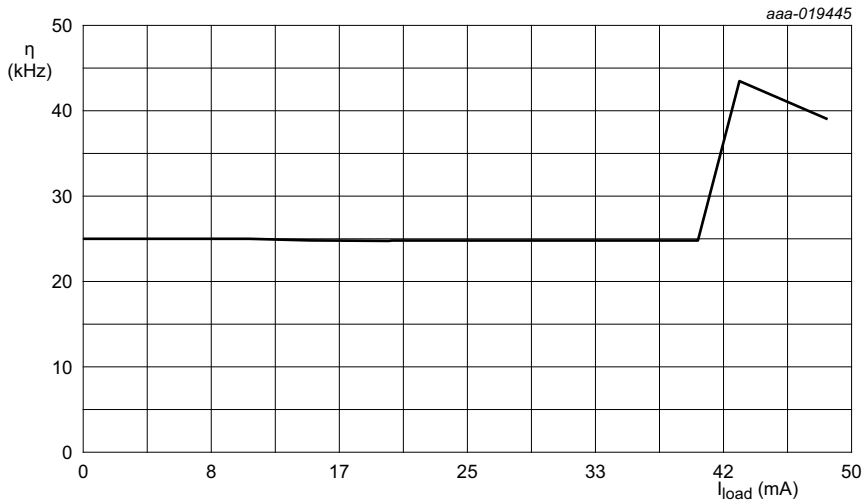
7.3 f_{sw} versus I_{out}



(1) 230 V
(2) 120 V

Fig 8. f_{sw} as a function of I_{out}

7.4 Current through inductor L

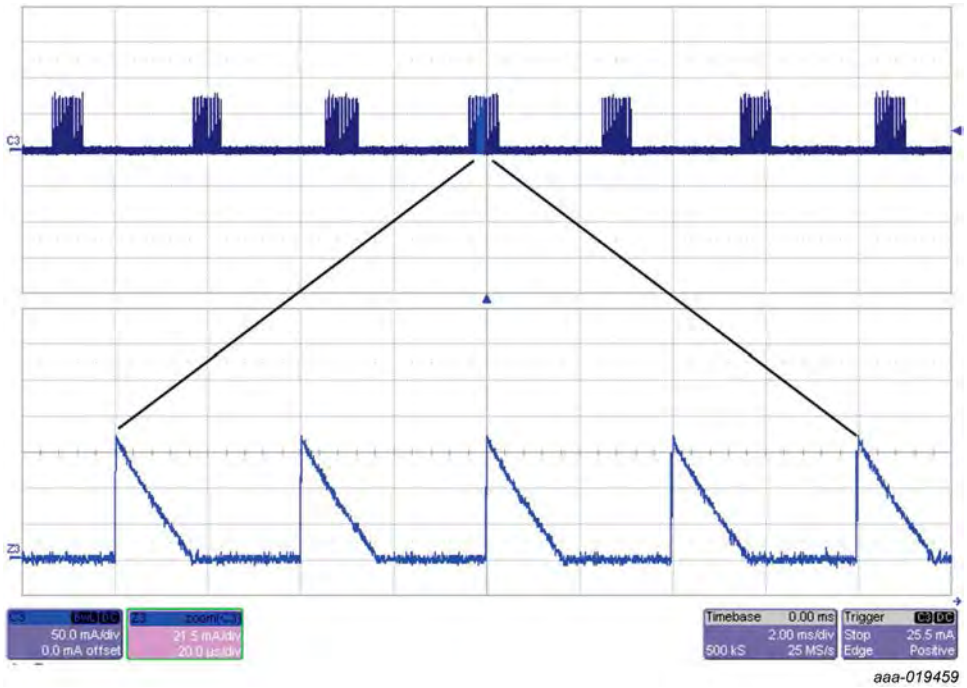


Fig 9. Waveform of current in inductor during burst mode

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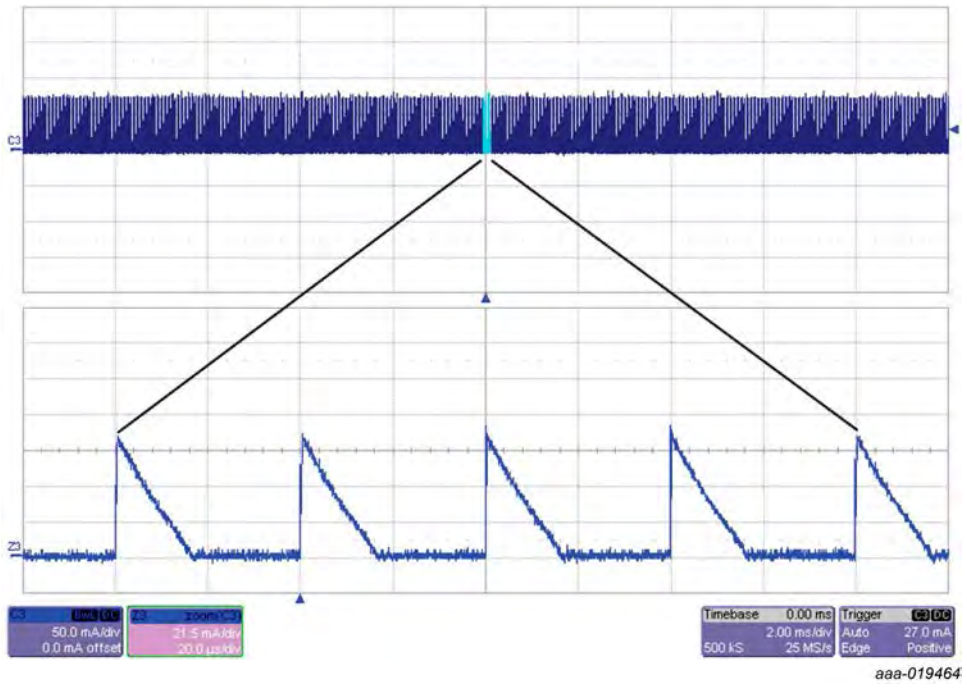

Fig 10. Waveform of current in inductor during DCM mode

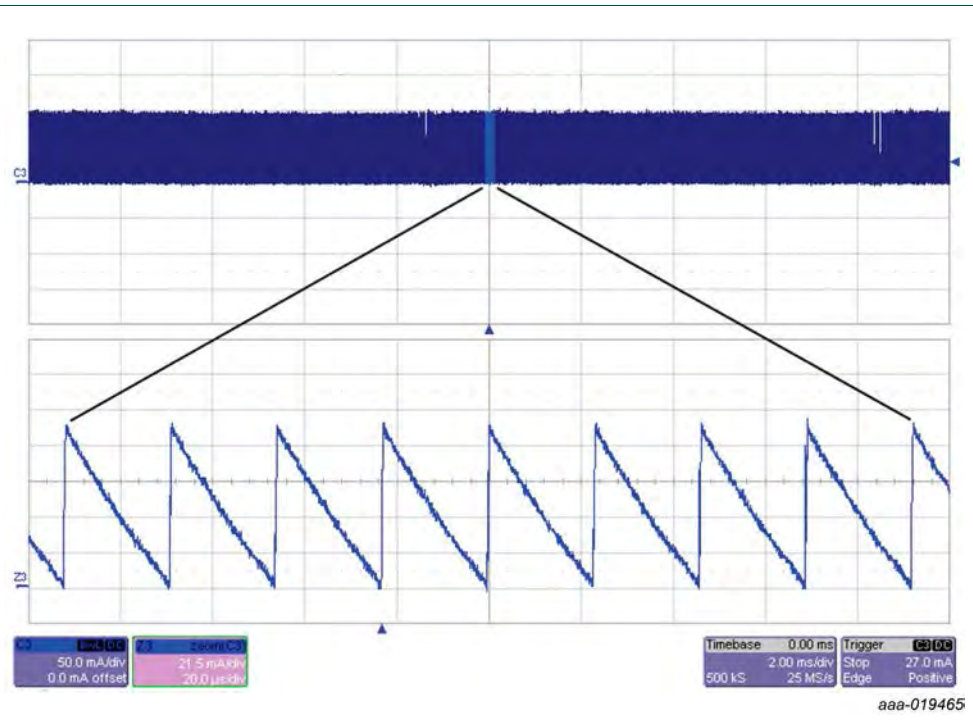

Fig 11. Waveform of current in inductor during BCM mode

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8. Schematic

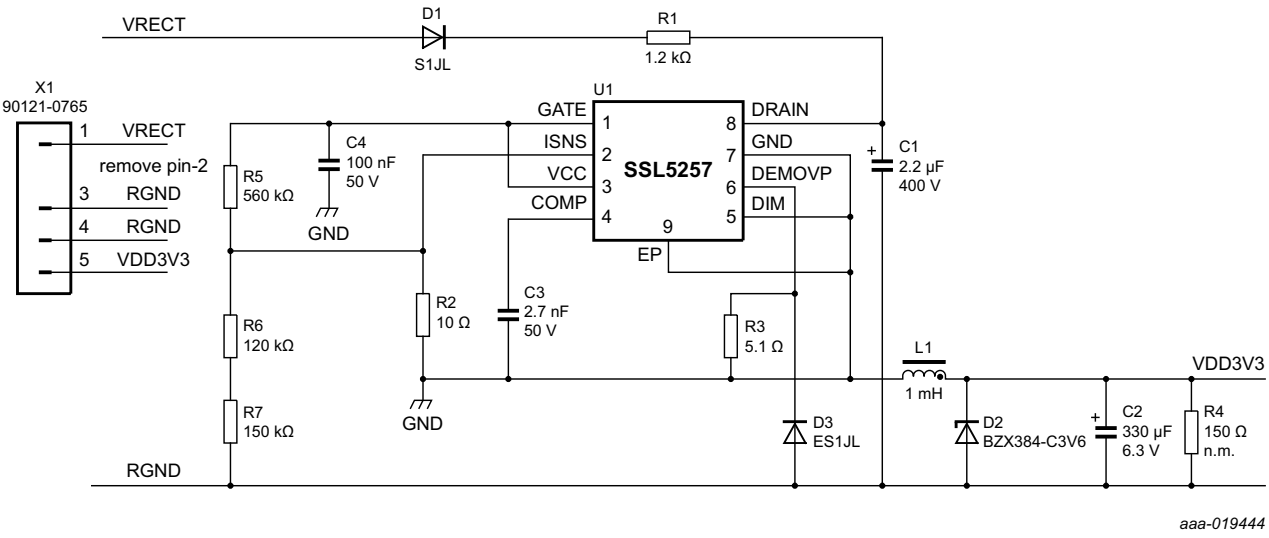

Fig 12. SSL5257DB1351 demo board schematic diagram

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9. Bill Of Materials (BOM)

Table 2. SSL5257DB1351 demo board BOM

Reference	Description and values	Part number	Manufacturer
C1	capacitor; 2.2 μF; 20 %; 400 V; ALU; THT	ECA2GHG2R2	Panasonic
C2	capacitor; 330 μF; 20 %; 6.3 V; ALU; THT	MCUMR6V3337M8X5	Multicomp
C3	capacitor; 2.7 nF; 10 %; 50 V; X7R; 0603	-	-
C4	capacitor; 100 nF; 10 %; 50 V; X7R; 0603	-	-
D1; D3	diode; 420 V; 1 A	S1JL	Taiwan Semiconductor
D2	diode; Zener; 3.6 V; 250 mA	BZX384-C3V6	NXP Semiconductors
L1	inductor; 1 mH; 170 mA	22R105C	Murata
R1	resistor; 1.2 kΩ; 5 %; 1 W; PR01; THT	PR01000101201JR500	Vishay
R2	resistor; 10 Ω; 1 %; 250 mW; 1206	-	-
R3	resistor; 5.1 Ω; 1 %; 250 mW; 1206	-	-
R4	resistor; 150 Ω; 1 %; 100 mW; 0805	-	-
R5	resistor; 560 kΩ; 5 %; 63 mW; 0603	-	-
R6	resistor; 120 kΩ; 5 %; 63 mW; 0603	-	-
R7	resistor; 150 kΩ; 5 %; 63 mW; 0603	-	-
U1	LED driver/dimmer SSL5257TE	SSL5257TE	NXP Semiconductors
X1	header; R/A; 1 × 5-way; 2.54 mm	90121-0765	Molex

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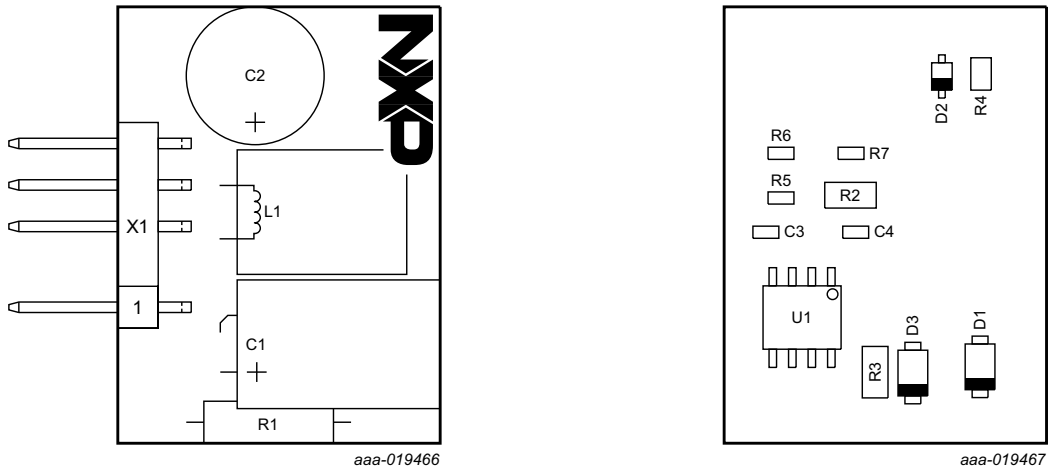
10. Layout and assembly



a. Top

b. Bottom

Fig 13. SSL5257DB1351 demo board PCB assembly

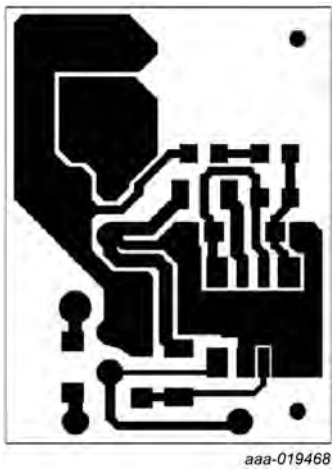


Fig 14. SSL5257DB1351 PCB layout

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11. Abbreviations

Table 3. Abbreviations

Acronym	Description
BCM	Boundary Conduction Mode
DCM	Discontinuous Conduction Mode
PCB	Printed-Circuit Board
PWM	Pulse-Width Modulation
SSL	Solid-State Lighting
VLC	Visual Light Communication

12. References

[1] **SSL5257TE data sheet —** Mains dimmable buck-boost LED driver IC 10 Ohm/700 V

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